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13. ABSTRACT *(Maximum 200 words)*

The Sun 4/60 workstation (SPARCstation) which were purchased according to approved changes in the original proposal have been extensively used by faculty, postdoctoral associates and graduate students. An additional station was acquired to be a file server to the other five. Eduardo Sontag has been using the equipment in his study of first order controlers. Eugen Speer has been investigating interface growth on cellular automaton. Zheming Cheng, a postdoctoral associate has done extensive simulations to understand limiting distributions arising from "quantum chaos". The SPARCstation is ideally suited for this significant applications. The equipment will be used for computerized simulations in nonlinear systems. (KT)

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Final Technical Report: AFOSR–89–0214

In accordance with the approved change in our original proposed plans, we have purchased five Sun 4/60 workstations (SPARCstations) for use by faculty, postdoctoral associates, visitors, and graduate students. These have been equipped with extra memory, one or two internal hard disks, floppy disk drives, and in one case a tape backup. One of these workstations, to be used for graphics applications, was purchased with color monitor and graphics accelerator. An additional SPARCstation was acquired to serve as a file server for the other five, and we also purchased two large external hard disks for the file server and a tape backup for the system. Other equipment purchased has included modems and printers. Software has been acquired, including specific software for the workstations from Sun, and Fortran and Pascal licenses obtained by a contribution to a site license to the University.

We plan to spend the remaining portion of the funds from the Rutgers University contribution to the grant to purchase an add-on board to support additional, high speed, numerical computation. At the moment we are considering the SKYbolt board from Sky Computers.

Installation of the workstations and fileserver was completed in December, since that time the equipment has been utilized for scientific computing by both the control theory and mathematical physics groups. Specifically:

Eduardo Sontag has started using the new equipment in various of his research projects. Some new examples of the equilinearization technique for control design of nonlinear systems where computed, to study the idea of recursively generating first-order controllers along trajectories. A fair amount of programming is still needed to be able to carry out the desired simulations in their complete generality, however. In his research in neural networks, Sontag used the new equipment to obtain explicit interconnection weights for the solution of the parity problem using sigmoidal activation functions. Symbolic computation techniques were used (for now only by remote login to another system, as appropriate software has not yet been installed on the new file server), together with differential equation solvers for the associated gradient systems.

Eugene Speer has been investigating a problem of interface growth in a particular probabilistic cellular automaton known as the Toom model. Here the interface is formed by imposing boundary conditions of opposite sign on the top and left, respectively, of the third quadrant of the square planar lattice. The resulting interface extends diagonally through the quadrant, and the problem is to determine the expected width of the interface at a point N lattice units from the origin, as a function of N. Monte Carlo simulations of a one-dimensional lattice system which approximates the two dimensional system have been carried out; the somewhat surprising result is that, at least at low noise levels, the width of the interface grows as $N^{1/4}$ rather than the expected $N^{1/2}$. Although theoretical understanding of the result has not been obtained, it appears that the rapidity and convenience of using the SPARCstation for such simulations is of great value.

Zheming Cheng, a postdoctoral associate of Joel Lebowitz, has done simulations to study the probability distribution of the number of lattice sites covered by a randomly

placed ring, ellipse or straight bar. (The problem arises in an attempt to understand work of Sinai on quantum chaos.) The question is whether there is a limiting distribution and, if so, whether it is Poisson. Consider, for example, an annulus of inner radius R and area A; a trial consists of randomly placing the center of the ring on the unit cell of the two dimensional square lattice, then counting the number of lattice sites covered by the ring. A large number of trials yields the distribution of the number of such points for a given ring, and the limiting distribution of interest is obtained as R becomes infinite, with A held fixed. The simulation results support the existence of a Poisson limiting distribution with the area A as the parameter. For ellipses and straight bars, trials are also randomized over orientation; the limiting distribution is again Poisson for ellipses, but deviates significantly for bars. Other randomization procedures yield non-Poisson limits even for annuli. The SPARCstation is well suited for simulations of this type.

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